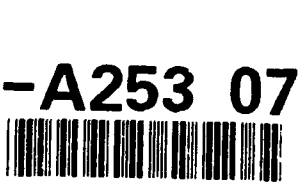
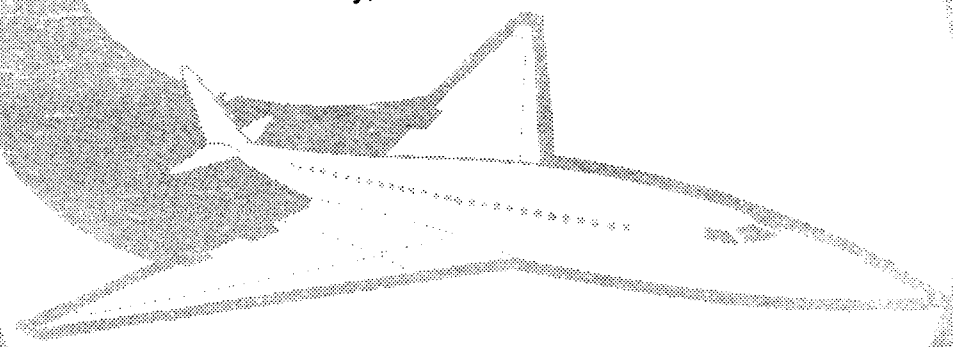


(2)

Technical Training for National Simulator Evaluation Specialist

Theos D. McKinney, Jr.



June 1992

DOT/FAA/CT-TN92/14

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Federal Aviation Administration

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15. Supplementary Notes

16. Abstract

This report examines the technical training needs of the Federal Aviation Administration (FAA) specialists who evaluate and qualify FAA recognized flight training simulators and devices. The need for this training is established and sources and methodologies recommended for initial, maintenance, and update courses.

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EXECUTIVE SUMMARY

The Simulator Evaluation Specialists (SESs) of the National Simulator Program (NSP) are overseeing the highly complex and specialized simulation equipment, widely used in pilot training, with little or no technical training in this arcane field. That they have been doing an outstanding job attests to their enthusiasm, dedication, and interest. This situation cannot, however, continue indefinitely. If the NSP is to realize its full potential, maintain professional stature, and continue to police this increasingly innovative segment of the industry, organized, coherent, and relevant technical training programs must be developed and utilized.

This report finds the need for this technical training to be genuine and urgent and recommends formats and forums for its immediate acquisition.

INTRODUCTION

The use of airplane simulators in, and in support of, flight training is today universally and aggressively supported by the industry as well as the Federal Aviation Administration (FAA). These flight training simulators are highly complex devices which use computers to join the sciences and the arcane arts to create the ultimate special effect, flight without flying. More importantly, the total ambience generated within their interiors, by this intelligent melange of mathematics, physics, computer science, physiology, and a host of other disciplines too numerous to mention, cannot be easily distinguished from an actual operating aircraft cockpit. In order to quantify and assign the training value attributable to a given simulator, used in place of actual airplane flight time, the Agency has promulgated standards to which these devices must conform. The responsibility of assuring and enforcing the conformance of these aircraft flight training simulators and flight training devices with these standards has been given to the National Simulator Program (NSP`. The cutting edge of the program's evaluation efforts is the team of 15 Simulator Evaluation Specialists (SESs) (figure 1), who are about equally resident in the Project Development Section and the Field Section. The Project Development Section is located in Atlanta, GA, at the Southern Region Headquarters, and the Field Section is dispersed among Flight Standards District Offices (FSDOs) as noted in figure 1. These inspectors, though assisted and supported by the remainder of the organization, must decide, after the systematic administration of objective and subjective tests, and the application of considerable judgment, whether a given device meets the appropriate standards and accurately replicates the subject aircraft. This they have been doing in a most professional and competent manner since the program's inception in 1981.

However, there is no formal training program in the fundamental technicalities and techniques of simulator mechanization existing for this aviation safety inspector specialty. Therefore, all the special skills and knowledge required to understand simulator operation and functioning must be acquired through on-the-job associations, independent study, or other ingenious pursuits.

In order to alleviate this almost total reliance on unstructured learning and to assure an organized, coherent, and relevant training program, the National Simulator Program Manager, (NSPM) has, under the auspices of the 1991 Executive Potential Program, commissioned this study of technical training needs and appropriate technical training opportunities. This report will evaluate pertinent existing short courses, in and out of the Agency, and will compare them to a suggested ideal curriculum. The result of this effort will be specific suggestions and recommendations to the NSPM on ways to fill this training vacuum.

RESULTS AND DISCUSSION

The effort to investigate training requirements for the SES and to proffer recommendations in keeping with the results of that investigation is divided into five parts. They are:

1. THE TASK

Just what is it that these specialists do and will be asked to do in the foreseeable future; and does this activity require or will it be enhanced by technical knowledge and training?

2. PREPARATION

What effect does and will previous education, training, and experience have upon the specialists' need for, acquisition of, and receptivity to specific training initiatives?

3. OBJECTIVE

What will be the objective of this training and can that objective be quantified and measured?

4. IDEAL CURRICULUM

What elements should a curriculum, which will satisfy the above uncovered needs, have? Should the Agency undertake to generate and teach such a curriculum internally or seek other alternatives?

5. SHORT COURSES, EXTANT

Are there any existing courses that meet, or can be adapted to meet the identified needs of the program?

1. THE TASK

The principal and unique duty of the SES is the conduction of initial and recurrent evaluations of flight training simulators for which FAA approval is sought. Additional duties for members of the Project Development Section, in which the Field Section has been invited to participate, include the development of directives, advisory circulars, and regulatory recommendations. A collateral duty for Field Section members is the surveillance of simulators geographically grouped near their domicile. However, simulator evaluations are the primary focus of both sections' activities.

Inspectors were accompanied on several initial and recurrent evaluations specifically for this report, in order to obtain a current assessment of the factors involved. Technical interactions between inspectors and simulator sponsors were observed and sponsor comments were invited. These evaluations are conducted in accordance with reference 1. In order to effectively conduct these evaluations, the specialist requires aircraft-specific knowledge and training, which is adequately possessed and addressed by references 2, 3, 4, 5; and generic simulator knowledge and training, which has been neglected. The inspector must observe, interpret, and evaluate objective test results, which are presented in tabular or graphical format, in accordance with pertinent Agency documents. The specialist must also subjectively evaluate the simulator, for accurate replication, by executing flight scenarios usually performed in the aircraft and comparing the recollection of aircraft response to that of the simulator.

At the completion of all tests, the specialist conducts an out-briefing for the simulator operator where the total evaluation and equipment performance is reviewed. Can all this be successfully done without an in-depth knowledge and understanding of the mechanics of simulator mechanization? Yes! As can be enthusiastically attested to by the excellent reputation, both personally and professionally, of the highly accomplished professional pilots who are the SESs; and by the respect in which they and the NSP are held by the industry.

Can it continue to be successfully done and/or is the situation desirable? No! This situation is not fully in accord with the " . . . FAA team of technical experts . . ." envisioned by Order 8000.48 (reference 6) which commissioned the National Simulation Evaluation Team (NSET), predecessor organization to the NSP, in 1981, nor with the " . . .recognized national expert and consultant with a high level of technical knowledge and professional expertise concerning state-of-the-art aircraft simulation . . ." of their current position descriptions (reference 7). Not only that, but as simulators become even more sophisticated and able to generate the flawless illusion, they will demand more, much more, from the technical acumen of their purveyors and their overseers.

One particular area of concern is, during the out-briefing, or if difficulty is encountered while testing is in progress, when the specialist is expected to converse knowledgeably with the simulator operator. This dialogue might include the merits of test results in contention and perhaps speculation on the cause of and remedies for observed discrepancies. While it may not be necessary or desirable for the specialists to be able to design, build, or program a simulator extemporaneously, they should be able to comfortably discuss all aspects of simulator technology with operator personnel. Additionally, the recent approval of Advisory Circular 120-45A, Airplane Flight Training Device Qualification (reference 8), which authorizes FAA approval of flight training

devices through Level 5 by FSDO inspectors consulting with the NSP, exacerbates this situation. When these FSDO inspectors seek out their consultants with simulator questions, a great many of which will be technical, they will expect correct responses delivered with the confidence and authority borne of knowledge and familiarity.

2. PREPARATION

The SESs are typically and traditionally chosen from the Air Carrier Operations Inspector ranks. This means that they are accomplished pilots, are familiar with the FAA in general, flight standards in particular, and have had extensive flight training, much of it using simulators. Occasionally, a recruit is garnered from other agency sources and even more rarely from industry, but all are expert airmen. The transference of this aviation expertise to simulator evaluation and testing is easily understood, particularly the familiarity with tabular and graphical data presentations and its application to objective testing. Understandably, flying and increasing their repertoire of type ratings, aircraft qualifications and proficiency, in support of their subjective testing, is their principally voiced concern. An item of considerable interest to the specialists in this area is the actual and simulated implementation and operation of flight management systems and other highly automated and computerized systems associated with the new generation of aircraft. However, a solid underlying interest in simulator mechanics, by the specialists, could also be detected.

A poll of the essentially 15 evaluation specialists currently with the program shows that educational background is effectively equally divided between those with technical degrees, those with nontechnical degrees, and those without degrees. However, all have shown a high receptivity and tolerance for technical presentations by virtue of their extensive pilot training, regardless of prior academic preparation. Thus, training aimed at the middle, the nontechnically degreed, should prove the most appropriate.

3. OBJECTIVE

The FAA has traditionally trained personnel to a quantifiably identifiable level of expertise known as the training objective. That objective stated at the outset is always definitive, specific, and measurable. It is not so with this proposed training. This training proposes to educate specialists in the aura of technical simulation activity. Another salient characteristic of traditional FAA training is that it begins at a known starting point by the careful specification of prerequisite requirements so that the objectives can be met without redundancy or oversights. It is not so with this proposed training. A composite target student body has been identified. This was necessitated, as previously noted, because of the diversity and range of academic backgrounds among specialists. This target student and average simulator specialist is a college graduate with a non-physical science degree. Hence, the prerequisite for this training will simply be membership or an abiding interest in the NSP.

Historically, the agency has sought to qualify its surveillance and enforcement personnel to a standard which is at least the equivalent of that of the industry counterparts being regulated. In the case of the SES, this policy is probably neither feasible nor desirable due to the disparity in skills between agency and industry representatives. To wit the heavy emphasis, as forcefully expressed in Order 8000.48B (reference 5), that SESs be rated, proficient, and current pilots in the aircraft type which the simulator being evaluated replicates. This emphasis on pilot proficiency for the specialists is totally appropriate since the ultimate justification for the simulator's existence is as a training and testing tool. A tool which must convince the evaluator, and subsequently the student, of its authenticity in order to assure that the learning it imparts is transferable to reality. Operator and manufacturer personnel do not usually, nor are they required to, hold pilot qualification, though they may be extremely knowledgeable of the aircraft characteristics. However, they are far more astute about the functioning of the simulator. To imbue the average simulator specialist with the same level of simulator-facilitating expertise as the operating or manufacturing personnel would engender a training program of awesome proportion, as would qualifying most operator personnel to the same level of airmanship as the specialists.

Therefore, the objective of this training is not to enable these specialists to be facile manipulators of intricate mathematical expressions or artful applicators of scientific phenomena, although these outcomes are not objectionable. Rather, the objective is to enable them to become conceptually aware of and knowledgeably conversant with the details of flight training simulator technology. If it is absolutely necessary that a quantifiable objective be specified, then training is sought to no less than the comprehension level. Agency Order AC 3000.18D (reference 9) defines comprehension as " . . . knowledgeable of how and why a procedure or action should be performed. The student knows what is being said and can use the material to a limited degree. . ."

4. IDEAL CURRICULUM

The objective of this course will be to train or refresh, as appropriate, SESs to a high level of conceptual awareness about the latest techniques in simulator mechanization, construction, and operation. Since there is no desire to produce engineers ready and able to design and build breakthrough simulators on the spot, it will not be necessary to confound the students with an overwhelming presentation of technical minutiae. A key characteristic of this curriculum should be its ability to fully explore areas of expressed student interest at an academic level appropriate to that expression. Therefore, scheduling and content must be flexible and instructors must be thoroughly versed in their subjects.

The ideal curriculum would consider, but not be limited to, the following major elemental simulator components at a depth suitable for the identified NSP target audience. The subject areas need not be presented as contiguous blocks as shown, since interleaving the interdependent material would greatly enhance the overall presentation.

a. Mathematical Modeling

The overall concern in this area is to present the necessary and vital information without becoming bogged down in a lot of elegant manipulation of expressions or with irrelevant digressions. The emphasis should be on graphical and pictorial presentations of the universality of the dynamics of the mass, dash pot, spring combination, and the differential equation it produces. Other key analytical concepts that should be explored and compared here are the following:

(1) Difference equations
(2) Transfer function
(3) Time Domain
(4) Frequency Domain
(5) S-Plane
(6) Z-Plane

Also to be mentioned is the necessity of solving six equations simultaneously and the role of stability derivatives in their derivation. And finally, the dynamics and mechanics of the cockpit flight controls and instruments should be thoroughly discussed.

b. Computers and Programming

The major thrust here is the digital computer, but a short period devoted to analog computation would not be wasted since many builders still use some small analog subassemblies, and this technology is still alive and well in many flight training devices. In the area of digital computers, after a thorough discussion of architecture and hardware trends, programming languages should be presented. Some key concepts in this area are the hierarchy of machine, assembly, and compiler languages and the utility of various operating systems in simulation. Several specific languages should be briefly examined with emphasis being placed on ADA as the Department of Defense (DOD) standard.

c. Motion Systems

The emphasis here will certainly be on the 6-leg hydraulicly actuated 6° of freedom synergistic motion base, as it has become the industry standard. However, there exist a sufficient number of different configuration, degree of freedom combinations, to pique the interests of all.

d. Visual Systems

A thorough examination of current and past visual systems, including theoretical and practical aspects of image generation, should be conducted. Emphasis should be placed on the limitations and unique characteristics of various systems. Of course, examination of experimental and developmental visual systems is desirable. Optical theory sufficient to explain and supportive of compatibility requirements with the human eye, in the simulator environment, should be presented.

e. Physiology of Pertinence

It is important for any flight training simulation aficionado to be aware of the pertinent human physiology which is being fooled. As pilots, the specialists are undoubtedly acutely aware of the human foibles and limitations related to flight. However, it is felt that an intense review is bound to uncover some new material. Particular emphasis should be placed on the vestibular system, the motion perception, the visual acuity, and the limitations. The quality and accuracy of simulator replication and its impact upon acquisition, retention, and transfer of skills would also be appropriate. An area of particular interest to the evaluation specialist would be what activities, behaviors, or procedures would best assure that their evaluations are truly a comparison of simulator to aircraft and not simulator to simulator or even a single simulator to itself.

f. Laboratory

It is felt that periodic sessions allowing hands-on contact with an operating simulator would enhance the understanding of everyone associated with the NSP. Accordingly, students should be able to program some aspect of the simulator and examine the results of their handiwork. Also, various coefficients of the aerodynamic model might be varied to rectify real or imagined faults or to measure what deviation from the norm is required before an evaluator would notice the abnormality.

g. System Integration

The methodology for joining of the foregoing technologies into a unified coherent cooperative system, the flight training simulator, is not always obvious. Some consideration of the why and wherefore of the many necessary design tradeoffs will undoubtedly explain many perplexing design outcomes.

5. SHORT COURSES, EXTANT

There are, at the present time, four relevant short courses (each of which is approximately 1 week, 5 class days, in duration) available. One of these courses is offered within the Agency and the remainder out-of-Agency. The three out-of-Agency courses, whose announcements are included in appendix A, are offered at the Massachusetts Institute of Technology (MIT), The State University of New York at Binghamton, N.Y., and the Cranfield College of Aeronautics, Cranfield, England. Each of the courses is offered once a year at approximately the same time.

It is interesting to compare the introduction or objectives, as well as the tuition of each course as stated in the announcements. It is reported by attendees at these courses that the actual thrust and presentation closely follows the descriptive statements. Only the Binghamton course was personally attended during this study. The content and delivery at Binghamton did accurately reflect the announced objectives. Therefore, it is felt that the course announcements, along with attendee comments, can be used to evaluate and compare the appropriateness of these courses for this purpose.

The Cranfield course is designed to introduce technical graduates to the application of the principles already learned to the simulation environment. It appears to be more academically rigorous than the NSP application requires, and the announcement specifically states that the course "will be of great benefit to those possessing a degree in engineering, physics or mathematics". This course is clearly not aimed at the NSP target audience of the nontechnical degreed.

There is little in the MIT announcement to indicate how rigorous the presentation would be. However, attendees have reported that the level of mathematical involvement considerably exceeds the NSP target level.

The Binghamton course, from both knowledgeable reports and personal observation, strikes the desirable balance between the intellectual rigor and conceptual grasp that the NSP seeks in its training program. Of the out-of-Agency courses, this one best suits the needs of the NSP. Preliminary inquiries with the sponsors of this course indicate that they would conduct the course at a site supplied by the program for approximately $1350.00 per person provided enrollment exceeded 35 (see appendix B). It is felt that this figure could be reduced through further negotiation. They are also amenable to group registrations at their regularly scheduled presentations and would extend generous discounts to group registrations of 10 or more persons.

It should be noted that each of these courses carries with it the implications of after-class socializing. The Cranfield course announces "the accommodation fee of 230 pounds covers full board residence from Sunday afternoon until Friday after lunch," a clear indication that participants will be eating and socializing together. The MIT course promises ". . . an informal reception . . . at the end of the first day's class and a dinner . . . on Thursday evening. . . " The Binghamton course offers daily group lunches, an evening reception, and a dinner with a guest speaker. The point is that these quasi-social functions are an important adjunct to the lectures. A significant portion of the course value is contained in this orchestrated socializing of the professionally diverse student body.

Lacking from each of these courses, though, is an element considered equally important: laboratory sessions. It is felt that, for NSP purposes, specialists during training should experience the actual manipulation of simulator parameters and the attendant outcomes. The proposed structure of these laboratory classes was discussed in the previous section.

Agency training for simulator evaluators is scarce and lacking in depth. This is undoubtedly due primarily to the following three reasons:

a. The SESs are a small group compared with other Agency specialties and easily overlooked.

b. The SESs are usually recruited from other Agency specialties and are considered fully trained in Agency policy and techniques, since they will have experienced the Agency's considerable course offerings for Aviation Safety Inspectors, Airspace System Inspection Pilots, and Human Resource Managers.

c. The Simulator Evaluation Program appears to be going well with the training policies now in effect. (The why fix it if it doesn't appear to be broken syndrome, the antithesis of improvement and prevention.)

As a result, the only course offering in the Agency inventory is Academy Course No. 22102, Flight Simulator Evaluation. This course was designed, though it has been updated, to prepare Aviation Safety Inspectors (Operations) to discharge simulator evaluation responsibilities which they had prior to 1981, and the advent of the NSP. It is not the course for experienced SESs seeking to acquire or refresh their technical expertise in flight training simulators.

While personal attendance at this course could not be scheduled during the period of this study, careful examination of the course materials (lesson plan, handouts, etc.) and conversations with the instructor indicate that the major emphasis of this course is on the procedural and regulatory aspects of simulator evaluation. There is also instruction and laboratory practice in running the approval tests and in reading and interpreting the results. But lacking are the why's and wherefore's of the simulator's mechanizing foundation. This conclusion is borne out by the Academy Course Catalog description of this offering shown in appendix C.

This course, while excellent for FSDO inspectors, particularly in light of the flight training device evaluation authorizations they have received under Advisory Circular 120-45A, is of limited value to the NSP SES. The NSP specialist is better served by acquiring the procedural aspects of simulator evaluation through on-the-job experience and should seek the in-depth technical exposure in other forums.

One briefly examined area of training that could prove very beneficial as a source of continued proficiency is Computer Base Instruction (CBI). While this training requirement probably does not justify the development of a new CBI course, with its attendant outrageous costs, the Agency does have unlimited access to the Plato CBI System. Plato is the registered trademark for the Control Data System of Computer Based Education Development and Delivery System. The Agency possesses a Plato system installed on a mainframe computer at the Aeronautical Center, under the control of AAC-922, which is available Agency-wide via telephone circuits. All of the necessary communications software can be ordered through the OATS contract. Resident in this system is an enormous library of interactive lessons on every imaginable subject. A search of this data base, and a joining of appropriately related lessons into a coherent course, could prove fruitful, and at a cost much less than a full blown initial CBI development. Available time did not allow a full investigation of this promising course option and/or adjunct.

CONCLUSIONS

1. There is a definite need for Simulator Evaluation Specialists (SESs) to be trained, albeit not to the highest level of proficiency, in the what, why, and how of flight training simulator mechanization.

This training need can best be met, from among the existing courses, by the SUNY Binghamton offering. It will be less expensive to send groups of 10 or more students to the Binghamton campus for this training, where they will receive the benefits of both the curriculum and extra curricular activities.

2. In addition to formal classroom instruction, there is a requirement for laboratory currency. This currency could be maintained and the practicalities of simulator mechanics examined, if laboratory time could be scheduled for the National Simulator Program (NSP) on the B-727 Simulator at the Aeronautical Center or the General Aviation Simulator at the Federal Aviation Administration (FAA) Technical Center.

3. Simulator specialists of the NSP, in the press of everyday demands to evaluate and approve simulators for training, have scant time to reflect upon the mechanization or state-of-the-art that causes them to go. The members of the Project Development Section have specific assignments when not actively in the field examining candidate simulators. Members of the Field Section have been invited to participate in these projects but have received no firm assignments in this area. While time is tight, technical proficiency, once acquired, should be maintained.

4. The NSP has two annual 3-day meetings, held at intervals of approximately 6 months, during which all members of the program come together to discuss subjects of mutual concern and interest within the program. Attendance at one meeting, while admittedly a small sample, indicated that subjects discussed centered around procedural and personnel issues. Technical issues were rarely broached, and when they were broached, were not examined in great depth.

5. On-the-job training (OJT) has been used very effectively by the NSP to initiate new SESs into the ways of the program and to maintain standardization. No single individual, however, has been designated as OJT instructor, and there can be loss of standardization under these circumstances. The possible loss of training standardization can be due to the omissions of a series of instructors, each assuming some vital training was covered by another, thus leaving the trainee with glaring gaps in preparation. Or the possible loss of standardization can be due to the inevitable contamination of information that occurs after several iterations of transfer from seasoned specialist to new specialist. Either or any combination of these effects can possibly result in a total loss of standardization.

It is believed that this unfortunate outcome thus far has been avoided by the NSP due to its small, tightly knit, organizational structure, and low turnover rate.

RECOMMENDATIONS

1. It is recommended that the SUNY Binghamton Course be used to fill the training void in simulation techniques and science now being felt by the Simulator Evaluation Specialists (SESs) of the National Simulator Program (NSP). They should attend the regularly scheduled session in Binghamton.

2. The classroom instruction in the above recommendation should be augmented with laboratory exercises using Agency simulators, if available. These laboratory exercises should examine the effects of changes in various key coefficients upon simulator response, extreme excursions of the actual dynamics from the ideal model before subjective detection, and other timely investigations. The actual programming, and other activities necessary to conduct the investigations, should be done by the specialist in consultation with available Agency simulator professionals.

3. It is recommended that, rather than having the Field Section participate in the office projects, they be designated to become "expert" in some simulator subsystem of their own choosing. Some examples of candidate subsystems are:

a. Mathematical Modeling

(1) Aerodynamic
(2) Atmospheric
(3) Flight Control Systems
(4) Flight Controls

b. Visual Systems

(1) Image Generation
(2) Image Projection

c. Computers

(1) Operating Systems
(2) Hardware
(3) Languages
(4) Programming
(5) Computer-Based Instruction

d. Motion Systems

(1) Washout Algorithms

e. Physiology of Pertinence

(1) Physiology of Motion Sensing
(2) Physiology of the Eye

Though each member of the Field Section should be allowed to choose their own area or areas of in-depth specialization, the same area of interest could be attended by several members. Multiple coverage and overlapping of interest areas are seen as synergistically beneficial and are to be encouraged rather than avoided. However, an effort should be made to have at least one person matched with each area to assure complete coverage. Once an area of "intense interest" is selected, the specialist should be allowed to pursue and develop it as an independent investigator. It is suggested that members of the Project Section also be invited to participate in this program. The specialists will be expected to become extremely knowledgeable and conversant with their chosen area of "expertise" to include currency with the latest state-of-the-art/science efforts.

4. It is recommended that, during the 3-day semiannual NSP meetings, that 1 full day of the agenda be devoted to technical discussions. These discussions could be tutorials (conducted by visiting professors), state-of-the-art presentations (by researchers or manufacturers), or other presentations of technical interest, some conducted by "expert" members of the NSP (see Recommendation No. 3) in their areas of expertise.

5. It is recommended that, at any given time, one SES be designated as On-the-Job Training (OJT) Instructor and charged with the responsibility of assuring standardization among new specialists. It is recognized that there is great value in exposing new specialists to the variety of viewpoints that would be received by training with several experienced specialists. However, it is suggested that this exposure be postponed until after the new specialist has completed the initial OJT curriculum.

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APPENDIX A

COURSE ANNOUNCEMENTS

Massachusetts Institute of Technology
August 7-11, 1989
Summer Session Program 16.36s

Fundamentals of Flight Simulation

MIT ANNOUNCEMENT

Out-the-window Visual Displays and Requirements

Human visual system characteristics

Field of view

Infinity optics

Flicker and update rate

Resolution, contrast, color

Depth cues, perspective, texture

Display Implementation

CGI systems

Calligraphic and raster display systems

Algorithms and techniques for creating synthetic imagery

Area-of-interest and helmet mounted systems

Tuition
Tuition for the Program is $1,300, due and payable upon notification of admission. Academic credit is not offered.

Cancellation/Refund Policy
Registrants who notify the Office of the Summer Session of cancellation of their plans to attend a program less than one month (28 calendar days) before the start date will be charged a cancellation fee of 20% of the tuition. If the registrant does not appear for the program, full tuition will be charged. No refund of tuition will be made to those who arrive late or leave before completing a program in which they have been registered.

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The Netherlands
Instructor

Please see information on the back of this page.

Important Information

Office of the Summer Session
50 Ames, Room E19-356
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Telephone (617) 253-2101 (9:00 am to 4:30 pm)
Dormitory (617) 253-6561 (after 4:30 pm)
Telex 92-1473 MITCAM
FAX (617) 253-8042
FAX Verification (617) 253-2101

Admission

In order to maintain highest standards, the enrollment in each Special Summer Program is limited according to the facilities and staff which are available. If a program is not over-subscribed, applications for it will be considered up to one week before it begins, nevertheless, applications should be submitted as early as possible. Application forms can be obtained from the Office of the Summer Session. The Institute reserves the right to select those applicants whose qualifications and experience suggest that they will receive the most benefit from the program for which they are applying. Neither admission nor dormitory reservations are transferable except by the specific authorization of the Office of the Summer Session, and then, only when evidence of the qualifications of the proposed substitute has been filed in advance.

Occasionally, it is necessary to cancel a program either because a key faculty member will not be available or because the projected enrollment is too low. Every effort is made to announce such a cancellation at least three or four weeks before the scheduled start of the program.

The Massachusetts Institute of Technology admits students of any race, color, sex, religion or national or ethnic origin to all rights, privileges, programs and activities generally accorded or made available to students at the Institute. It does not discriminate against individuals on the basis of race, color, sex, sexual orientation, religion, handicap, age or national or ethnic origin in the administration of its educational policies, admissions policies, scholarship and loan programs and athletic and other Institute-administered programs and activities, but may favor US citizens or residents in admissions and financial aid.

The Institute has adopted an affirmative action plan expressing its continuing commitment to the principle of equal opportunity in education.

Inquiries concerning the Institute's policies and compliance with applicable laws, statutes and regulations (such as Title IX and Section 504) may be directed to Dr. Clarence G. Williams, Special Assistant to the President and Assistant Equal Opportunity Officer, Room 3-221, (617) 253-5446. Inquiries about the laws and about compliance may also be directed to the Assistant Secretary for Civil Rights, US Department of Education.

Fees

Payments by Check, Draft or Money Order: Registrants whose admission has been approved will receive a letter of notification and invoice (payment to be submitted no later than two weeks before the scheduled program). Payment should be in US dollars and sent directly to the Office of the Summer Session, Room E19-356, MIT, Cambridge, Massachusetts 02139. Bank transfers should be made directly to the First National Bank of Boston and must be received no later than the Friday prior to the program date. Inclusion of identifying data (name, program number and invoice number) with the wire transfer will aid us in properly crediting your account. If payment is not received by the specified date, the Institute reserves the right to cancel admission whenever other applicants are seeking places in limited programs.

Contract/Purchase Orders: Registrants whose tuition and/or housing is to be covered by a government contract or company purchase order should return the invoice with the necessary papers no later than two weeks before the scheduled program to Office of the Summer Session, Room E19-356, MIT, Cambridge, Massachusetts 02139. If it is not possible to obtain the Contract or Purchase Order by the specific date, the registrant may submit a letter of authorization for payment. Enrollment becomes valid only upon receipt of a Purchase Order or a Letter of Authorization. Each Purchase Order or Letter of Authorization should include the name of the applicant as well as the name and program number for which the tuition is intended. Government Purchase Orders should have prepayment authorization.

Since housing charges (if any) are not covered by government contract, these payments must be received independently from the registrant under the same guidelines as the tuition.

Please note: A government contract or a company purchase order does not reserve a place in a program, it must be preceded or accompanied by a completed application for admission.

Receipts: Receipts are given at registration.

Refunds: Registrants who notify the Office of the Summer Session of cancellation of their plans to attend a program less than one month (28 calendar days) before the start date, will be charged a cancellation fee of 20% of the tuition. If the registrant does not appear for the program, full tuition will be charged. No refunds of tuition will be made to those who arrive late or leave before completing a program in which they have been registered. Refunds for dormitory: see Housing.

Registration

Registrants should report to the main lobby of the Institute, 77 Massachusetts Avenue (Building 7 Lobby), between 7:30–8:00 am on the day the program begins. Detailed information about special MIT facilities and services will be given to each registrant along with directions to their scheduled classroom.

Mail and Messages: Registrants may have mail and messages addressed to them at the Office of the Summer Session. Mail should clearly indicate the registrant's name and program number. Urgent telephone messages may be called into the Office of the Summer Session and we shall attempt to contact the registrant in the classroom.

Housing

Dormitory Accommodations: The MIT dormitories on campus are available to all registrants. Usual accommodations start on the preceding Sunday and check-out by 11:00 am on the following Friday. Anyone wishing to stay Friday evening or beyond may do so on a "space available" basis and only by arrangement directly with the dormitory manager. Reservations are confirmed in the Notification of Admission and should be presented at the dormitory upon arrival. Persons who wish to make and/or alter dormitory reservations should notify the Office of the Summer Session promptly. Please make sure you specify on your application the type of accommodation you desire. Housing fees are payable to the Summer Session Office, E19-356, MIT, Cambridge, MA 02139. No money will be collected at the dormitory. Specific room assignments are made on your arrival at the dormitory desk. There are no refunds of dormitory fees for Friday, Saturday, or holidays during a two-week program.

New West Campus Housing, 471 Memorial Drive, Cambridge, Massachusetts 02139; (617) 253-6561 (Entrance on Amherst St. From Memorial Dr. turn right onto Fowler St., then left onto Amherst St.) Single $40 per night; Double $50 per night Children (6–14 yrs) $3 per night (accommodated in the same room as parents). Children under 6 years of age and pets are not allowed in dormitory. Children 15 years of age and older are charged the adult daily rate of $40 and receive a separate single room. No dormitory employee is authorized to modify these regulations.

Please Note: Bed linen and towels are supplied. Dormitories do not have private baths. Rooms for men and women may be on the same floor. The dormitory is open 24 hours per day, 7 days a week. Air conditioned rooms are available on a first come, first served basis.

Other Housing Accommodations: Some participants prefer to stay at nearby hotels. The Marriott Cambridge, the Hyatt Regency Cambridge and the Royal Sonesta are the closest to the MIT campus. A complete list of hotels/motels may be obtained by request from the Summer Session Office. Applicants who wish to make reservations must contact the hotel directly. Inquire about MIT rates at the time of reservation.

Dining Facilities: Meals are not included in tuition or dormitory fees (unless specified in a program brochure). There are many dining facilities on campus, including Lobdell and Twenty Chimneys in the Stratton Building (Student Center), Walker Memorial and the Faculty Club. In addition there are a variety of different restaurants surrounding MIT in the Cambridge/Boston area. A list of restaurants may be obtained on the day of registration in Room 5-134 (7:30–9:00 am) or at the Office of the Summer Session in Room E19-356 (9:00 am–4:30 pm, Monday through Friday).

Tourist Information: Tourist information can be obtained the day of registration in Room 5-134 (entrance at 77 Massachusetts Avenue) from 7:30 to 9:00 am, thereafter, at 50 Ames Street (Room E19-356) from 9:00 am to 4:30 pm, Monday through Friday.

JOINTLY SPONSORED BY:

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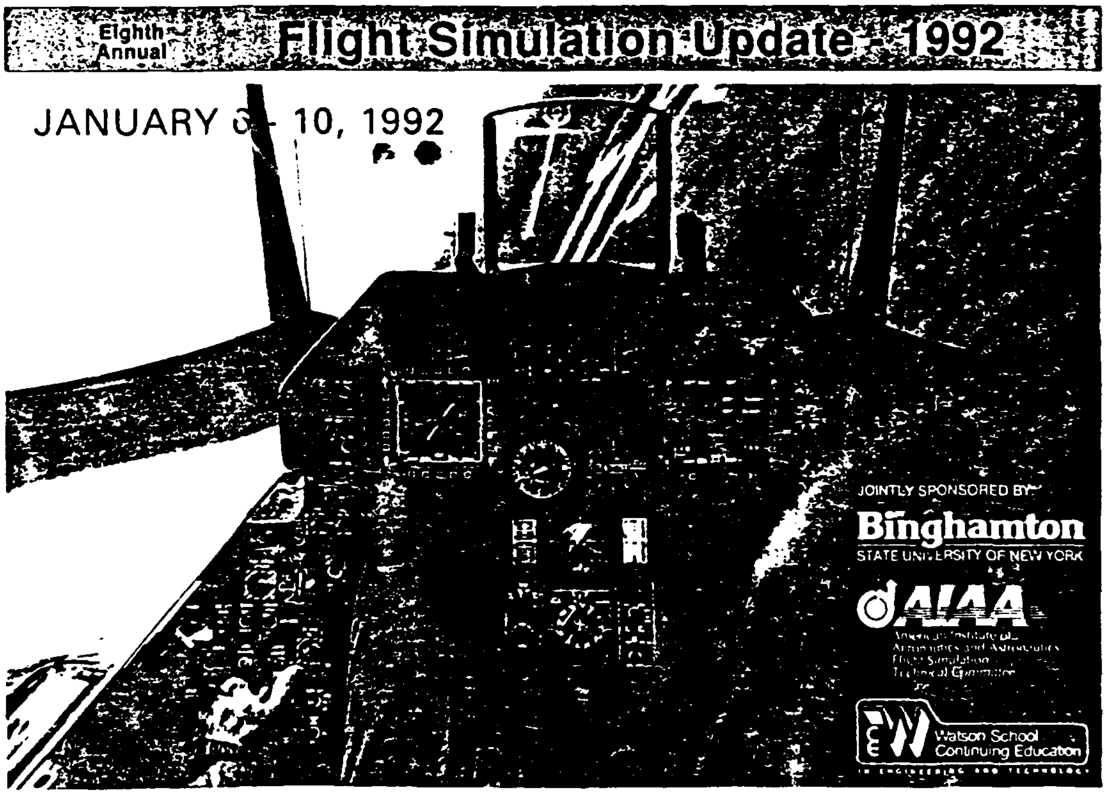
AIAA
American Institute of Aeronautics and Astronautics
Flight Simulation Technical Committee

Watson School Continuing Education
IN ENGINEERING AND TECHNOLOGY

OFFICE OF CONTINUING EDUCATION

Thomas J. Watson School of Engineering,
Applied Science, and Technology
State University of New York at Binghamton
P.O. Box 6000
Binghamton, NY 13902-6000



BINGHAMPTON ANNOUNCEMENT

E.g... Annual

Flight Simulation Update - 1992

JANUARY 6 - 10, 1992

WHO SHOULD ATTEND:

Engineers, system hardware and software design specialists, managers, and simulation support personnel including product sales/marketing representatives, and other professionals associated with the specification, design, testing, implementation, or acquisition of modern flight simulators. The scope and organization of this course are especially applicable to a variety of industry, government, military, and university personnel.

OBJECTIVES:

The course provides a comprehensive overview for professionals seeking a working understanding of the key components of this important technology. The program also serves as an important forum for practicing simulation engineers seeking a state-of-the-art update in system design, applications, and research trends..

COURSE DESCRIPTION:

Flight Simulation Update — 1992 is a unique five-day program co-sponsored by the American Institute of Aeronautics and Astronautics (AIAA) Flight Simulation Technical Committee and the State University of New York at Binghamton. Their cooperative efforts have produced a program that addresses all major components and subsystems comprising today's complex flight simulators. Topics are organized in a developmental sequence leading to systems integration, and ultimately to system synchronization, evaluation, and validation strategies.

Lecturers are leading experts recommended by a national advisory committee. Each topic will provide a general overview for less technically oriented participants, and then move toward a more in-depth examination of the topic, stressing problem resolution approaches and current applications at the engineering level.

TIME/LOCATION:

Sign in — January 6, 1992, 7:30-8 am. Continental breakfast — 8-8:30 am daily. Instructional program — 8:30 am-5 pm daily. **There will be a "Special Topic Session" on Friday afternoon dealing with networking of devices in a combined forces simulation presented by Gene Wiehagen of PM TRADE.**

The course will take place in Lecture Hall 9 on the SUNY Binghamton campus.

Cover Photo: A pilot's [illegible] view from the cockpit of a F-16 fighter simulator built by CAE-Link Corporation, Binghamton, NY. Photo courtesy of CAE-Link Corporation, a CAE Industries Ltd. company.

ESIG-3000 EMULATION *EVANS & SUTHERLAND*

REGISTRATION:

Fee includes morning and afternoon breaks, lunches, reception, dinner, and course materials. Please inform us at least two weeks in advance of any dietary restrictions.

Received by December 13, 1991	University/Government	Industry
1-2 persons	$1,075	$1,195
3-5 persons	$ 965	$1,075
6 or more persons	$ 915	$1,015

Advance registration is mandatory since enrollment is limited to ensure instructional quality. Registrations must be received before December 27, 1991. Use the registration form in this brochure, call the Office of Continuing Education at 607-777-2154 weekdays 9 am-4 pm, or FAX the registration form to 607-777-4822. Payment must be submitted prior to the start of the course. **No mail will be delivered to the SUNY Binghamton campus from December 20, 1991 to January 2, 1992 due to a university wide shut-down. All registrations after December 13, MUST BE FAXED (607-777-4822) OR CALLED IN (607-777-2154). An answering machine will take messages/registrations when the office is closed. These will be checked regularly.**

CONFIRMATION:

Confirmation and course information will be sent to registrants. If not received five days prior to the start of the course, call the Office of Continuing Education at 607-777-2154.

HOTEL ACCOMMODATIONS:

Specially discounted rooms ($60 single, $75 double, includes daily transportation to and from the campus; $55 single, $65 double, without transportation) have been reserved for course participants at the Hotel de Ville, 80 State Street, Binghamton, New York 13901. When making reservations (607-722-0000 or 800-322-3845), indicate that you are registering for this course. Complimentary transportation to and from the airport is also included. To ensure preferred accommodations, make your reservation before December 20, 1991. A list of other accommodations in the area is available on request. Reservations are the responsibility of participants.

CANCELLATION/REFUND POLICY:

Confirmed course registrations canceled within five business days prior to the starting date of the course (December 27 or later) are subject to a $50 cancellation fee. Cancellations received before December 27 will be refunded in full. Refunds are not issued after the course has begun. Individuals failing to cancel or attend are responsible for full payment of tuition. Substitutions may be made at any time prior to the beginning of the course by informing the Office of Continuing Education. If the course is canceled, full refunds will be issued. The Office of Continuing Education reserves the right to limit enrollments.

BINGHAMPTON ANNOUNCEMENT

Eighth Annual Flight Simulation Update - 1992

JANUARY 6 - 10, 1992

TOPICS

MONDAY, JANUARY 6, 1992

Simulation Purpose and Architecture
WALTER CHAMBERS
Naval Training Systems Center
- Introduction to Flight Simulation
  - Components of a simulator
  - Uses of simulations
  - Value of simulators

Training and Human Factors in Flight Simulation
EDWARD STARK, Retired
- Skill Learning
  - The characteristics of complex skills
  - Principles of skill learning
  - Sensory systems in learning
  - Training objectives
  - Instructional objectives
- Problems in Ensuring Transfer of Training
  - Definition of training objectives
  - Performance measurement and evaluation
  - Operating skills versus tactical skills
  - Simulator fidelity
- The Instructional Process
  - Measurement of performance and learning
  - Artificial intelligence/expert systems
  - Principles of learning and instruction
  - Instructor stations
- Training System Engineering
  - The system
  - The process

Mathematical Modeling I
FRANK CARDULLO
State University of New York at Binghamton
- General Concepts
- Vehicle Dynamics Modeling
  - Fixed wing aircraft
  - Rotary wing aircraft
- Coordinate Transformations
- Numerical Integration Techniques

Computer Systems Hardware
STEVE SEIDENSTICKER
Logicon, Inc.
- Simulator Processing Requirements
- Hardware Performance Issues
- Multi-Processor Architectures
- Current Suitable Computer Systems
- Input/Output Systems

Reception

TUESDAY, JANUARY 7, 1992

Computer Systems Software Issues
STEVE SEIDENSTICKER
Logicon, Inc.
- Operating Systems
- Modeling the Aircraft
- Modeling the Environment
- Instructional Features
- Impact of Ada ™

Visual Simulation Overview
WALTER CHAMBERS
Naval Training Systems Center
- Vision: A Purposeful Behavior
- Visual System Limits
- Visual System Types
- Critical Systems Requirement for Specific Tasks

Image Generation
MICHAEL FORTIN
Hughes Training, Inc.
- What is CIG?
  - Brief history
  - Applications
- Typical CIG Architecture
  - *Functional components*
  - System considerations
- System Characteristics and Features
  - Day/dusk/night
  - Raster/calligraphic
- Data Base Implementations
  - Components
  - Generation tools and techniques
- New and Future Trends
- *Radar/Sensor IG Issues*

WEDNESDAY, JANUARY 8, 1992

Visual Display Systems
JAMES DAVIS
IVEX Corporation
- Demands on the Display System
  - Made by the computer image generator
  - Made by the simulated aircraft type
  - Made by the training requirements
- Display Parameter Measurement
- Current Display Technologies
  - Real image displays
  - Virtual-image displays
  - Display input devices (monitors, projectors, light valves, etc.)
  - Raster versus calligraphy
  - Head-/eye-tracked area of interest (AOI) displays
- Novel Display Systems
  - Relay systems for non-CGI imagery
  - Using "foreshortened optical space"
  - Celestial sphere simulation and display
- Display R&D
  - Goals of R&D programs
  - Improvements in input devices
  - Improvements in optical assemblies
  - Improvements in overall system configuration
  - Requirements currently not addressed

Motion and Force Cuing I
EDWARD MARTIN
Wright-Patterson Air Force Base
- Reason for Simulation
- Mechanisms of Information Pickup
  - Definition/review of common terms
  - Perceptual systems
  - Haptic systems
- Platform Motion Simulation
- Washout Techniques
  - Onset cuing
  - High pass filtering
- Gravity Alignment

THURSDAY, JANUARY 9, 1992

Motion and Force Cuing II
FRANK CARDULLO
State University of New York at Binghamton
- Performance as a Basis for Motion Cuing
- Perceptual Aspects
- In-Cockpit Cuing Devices
- High-G Augmentation Devices
- Cuing Algorithms

Mathematical Modeling II
R. THOMAS GALLOWAY
Naval Training Systems Center
- Aerodynamic Modeling Conventions
- Aerodynamic Design Data
- Flight Test Data

Simulator Validation and Verification
R. THOMAS GALLOWAY
Naval Training Systems Center
- Test Requirements
- Test Methodology
- Flight Test Correlation
- Pilot Tailoring

THURSDAY EVENING:
Flight Simulation Dinner
DISTINGUISHED SPEAKER

FRIDAY, JANUARY 10, 1992

Control System Simulation
JOSEPH CORRAO
Opimicus Corporation
- The Control Loading Servo
- Digital Control Loading Systems
- Modeling Flight Control Systems
- Performance Verification
- Autopilot and AFCS Simulation

System Integration
GRANT McMILLAN
Wright-Patterson Air Force Base
- Human Sensation, Perception, and Cuing
  - The need for cue integration and synchronization
- Simulator Cue Integration
  - Simulator fidelity research findings
  - Simulator sickness
  - Minimizing simulator sickness and integration errors
  - Standards for cue integration
- Simulator Cue Synchronization
  - Sources of time delay and mismatch
  - Measurement of time delay
  - Effects of delay on pilot performance
  - Delay compensation techniques
  - Standards for acceptable delay

Special Topic Session
GENE WIEHAGEN
PM TRADE, US Army
- Application of Distributed Simulation in the Combined Forces Training Environment
  - Overview of State-of-Art
  - Network Architecture
  - Processing Requirements
  - Transport Delay
  - Future Applications

BINGHAMPTON ANNOUNCEMENT

Flight Simulation Update - 1992

JANUARY 6 - 10, 1992

INSTRUCTORS:

FRANK M. CARDULLO (Flight Simulation Update Technical Coordinator) is an Associate Professor of Mechanical Engineering in the Thomas J. Watson School of Engineering, Applied Science, and Technology, at the State University of New York, at Binghamton, New York. Among the courses he teaches are two graduate courses in flight simulation. Professor Cardullo conducts research into the perception and stimulation of visual and motion cues in flight simulators as well as computational methods for real time systems. He is an active consultant in the area and in the simulation of vehicle dynamics for many aerospace companies and US government agencies. Prior to his joining the faculty, 11 years ago, Professor Cardullo spent 14 years working in the simulation industry, most of it with Link. He is an Associate Fellow of the AIAA, a former chairman of their Flight Simulation Technical Committee, currently a member of the Life Sciences Technical Committee, and was awarded the deFlorez Training Award in 1991 for his contributions to simulation training. He is also a member of the IMAGE Society, the Aerospace Medical Association, and the American Association of Engineering Educators. Professor Cardullo is the author of 19 technical papers in both flight and ground vehicle simulation, numerous reports, and has been awarded a patent for the "Advanced G-Seat". His educational background includes undergraduate and graduate degrees in aerospace engineering and applied mathematics respectively.

WALTER S. CHAMBERS is one of the Navy's top experts in the field of visual technology and is currently managing the Advanced Simulation Concepts Division System at the Naval Training Systems Center. He graduated from Marshall University in 1961 with an engineering science degree. He immediately began his career in avionics research and design with the Air Force Avionics Laboratory at Wright-Patterson Air Force Base. Mr. Chambers has also worked with the Navy on such projects as the Polaris and Poseidon reentry systems. He was the project engineer for the Visual Technology Research Simulator development and principal investigator on several training effectiveness research projects. Mr. Chambers is the co-inventor of a fire fighting and control simulator, an advanced trainer for fleet training. He was awarded the deFlorez Training Award by AIAA in 1984 for his outstanding achievements in flight simulation and aerospace research.

JOSEPH M. CORRADO is a senior staff engineer with Opnicus Corporation, a US-based consulting firm, where he provides engineering consulting services to simulator manufacturers, major airlines, and military flight training centers. Mr. Corrado's specialty is simulation of [illegible]olving feedback controls including hardware design of simulator control loading and motion systems. He has been involved with dynamic system modeling for 13 years and has developed both analog and digital control loading systems, including design of fully digital systems. Mr. Corrado has developed aircraft flight control simulations for Link's A320, B767, B757, B747, B737, B727, DC9, DC10, L1011 full flight simulators, and Reflectone's T46, C5, A310, F28 flight simulators. In addition to service with Opnicus, he has served full-time on engineering staffs at the Singer Company-Link Division in Binghamton, New York; Reflectone Inc., in Tampa, Florida; and the Boeing Company in Seattle, Washington. Mr. Corrado holds a bachelor of science degree from Rutgers University and is a member of the AIAA.

JAMES L. DAVIS is a graduate of the Massachusetts Institute of Technology where he earned his BS, MS, EE, and PhD degrees in electrical engineering. Dr. Davis joined IVEX Corporation, Norcross, Georgia, in March 1991 as vice president of engineering after spending ten years with Redifusion Simulation. At Redifusion, he was manager of the Low Cost Visual Products Group at its facility in Crawley, England. Previous to that, he was R&D manager at its Arlington, Texas site (now Hughes Training, Inc.) He has published internationally on a range of topics including helicopter visual displays, sensor simulation, collimation, and low-cost visual systems. He is an active member of the AIAA Flight Simulation Technical Committee, the SID Symposium Executive Committee, and the NSIA Simulator and Trainer R&D Subcommittee.

MICHAEL FORTIN joined Hughes Training, Inc. (Redifusion) in 1974. His work involved many technical areas of visual simulation including data base development and production, technical marketing, and product management. His experience covers a wide range of image generation devices from the early Redifusion Novovew systems to the current state-of-the-art systems. He is currently engaged in defining visual system configurations for various applications utilizing the HTI MicroPOLY II as well as image generation devices from other sources. Mr. Fortin received his bachelor's degree in math from Florida State University. He was a naval aviator, flying light attack aircraft and was a Navy production acceptance pilot for the A-7D and E aircraft. He is currently the vice president of the Fort Worth/Dallas branch of the IMAGE Society.

R. THOMAS GALLOWAY is an aeronautical engineer and head of the Simulation Dynamics Branch at the Naval Training Systems Center. His responsibilities include the investigation of flight simulation requirements both for rotary wing and fixed wing pilot training. For many years he has been extensively involved with improving the fidelity of Navy flight simulators through the application of aircraft flight test technology. Mr. Galloway formerly worked as a flight test engineer at the Naval Air Test Center in Patuxent River, Maryland. He has participated in the development and evaluation of many Navy flight simulators and has authored several technical papers on flight fidelity test practices. Mr. Galloway holds a BSAE from Georgia Tech, an MSAE from Princeton University, and is a graduate of the US Naval Test Pilot School engineering curriculum. He is a member of the AIAA and the American Helicopter Society.

EDWARD A. MARTIN is a technical specialist in the flight and maintenance simulation branch, directorate of Support Systems Engineering, Aeronautical Systems Division at Wright-Patterson Air Force Base. He earned his BS in electrical engineering from the Virginia Military Institute, his master's in electrical engineering from Syracuse University, and PhD in biomedical engineering from Ohio State University. Currently he is involved in the definition of flight simulator display requirements with emphasis on factual, visual, and whole body motion alternatives for conveying task critical motion information. He is also responsible for the development and evaluation of training system requirements and the infusion of new technologies into training products. He has over twenty years technical and management experience in aerospace simulation, at Singer Company-Link Division and the Air Force Aeronautical Systems Division.

GRANT R. McMILLAN is an engineering research psychologist with the Armstrong Laboratory at Wright-Patterson Air Force Base. His 18 years of professional experience have emphasized the analysis and modeling of human performance in man-machine systems. During the past 13 years he has managed a research program investigating visual cueing, motion cueing, and time delay issues for flight simulator design. Dr. McMillan received his BA in psychology from Wheaton College and his MA and PhD in experimental psychology from Baylor University.

STEVE SEIDENSTICKER is a program development manager for the Tactical and Training Systems Division of Logicon, Inc. His most recent assignment was system architect on the Special Operations Forces Aircrew Training System. His responsibilities included overall design of a series of linked weapon system trainers to support mission rehearsal. Prior to that Mr. Seidensticker was the program manager on Logicon's Modular Simulator concept definition program. He has also managed the development of several sophisticated Instructor/Operator Stations. He has an undergraduate degree from Concordia Senior College and a master's degree in systems management from the University of Southern California. Mr. Seidensticker has also taught graduate level courses at West Coast University in on-line systems design, computer architecture, and microprocessors. He has written numerous technical papers on modular simulators, simulator networking, and instructor support systems. He also participates in a number of government/industry working groups developing various standards applicable to simulation.

EDWARD A. STARK received his BA in psychology from Wittenberg College in 1949, an MA in psychology from Bowling Green State University in 1950, and a PhD from the Ohio State University in 1955. He taught psychology at Bowling Green and Heidelberg College and currently teaches human factors engineering as a member of the SUNY adjunct faculty. He began his career in training research and simulation in 1955, participating in research in the training of infantrymen and armor crews with George Washington University's Human Resources Research Office at Fort Benning and Fort Knox. Dr. Stark worked as an engineering psychologist with Link Aviation, IBM, and Bell Aerosystems from 1958 to 1966. He returned to Link in 1966, retiring in 1989. During his career at Link he participated in a number of studies of aircraft, spacecraft, and tank crew training and simulation requirements. He contributed to the design of the US Navy's Experimental Training Simulation System and the Navy Pilot Training System. He was also involved in the design of simulators for air combat training and for the F-5, P-3C, F-14, UH-1, AH-64, and B-52 aircraft. He has been especially concerned with the levels of fidelity required in maximizing the training value of simulators and training devices and in minimizing the incidence and effects of simulator sickness. He has made more than thirty contributions to various technical conferences, simulation courses, and texts. In 1987, Dr. Stark was awarded the deFlorez award by the AIAA for his contributions to aerospace training.

REGISTRATION FORM

Flight Simulation Update — 1992 **January 6-10, 1992**

Name _____

Bus. Phone _____ FAX No. _____

Company Address (include internal codes) _____

_____

( ) Check enclosed (Payable to: SUNY Course #90323-116)

( ) Purchase order enclosed.

If paying by VISA or MasterCard, complete the following information:

( ) VISA ( ) MasterCard Exp Date _____

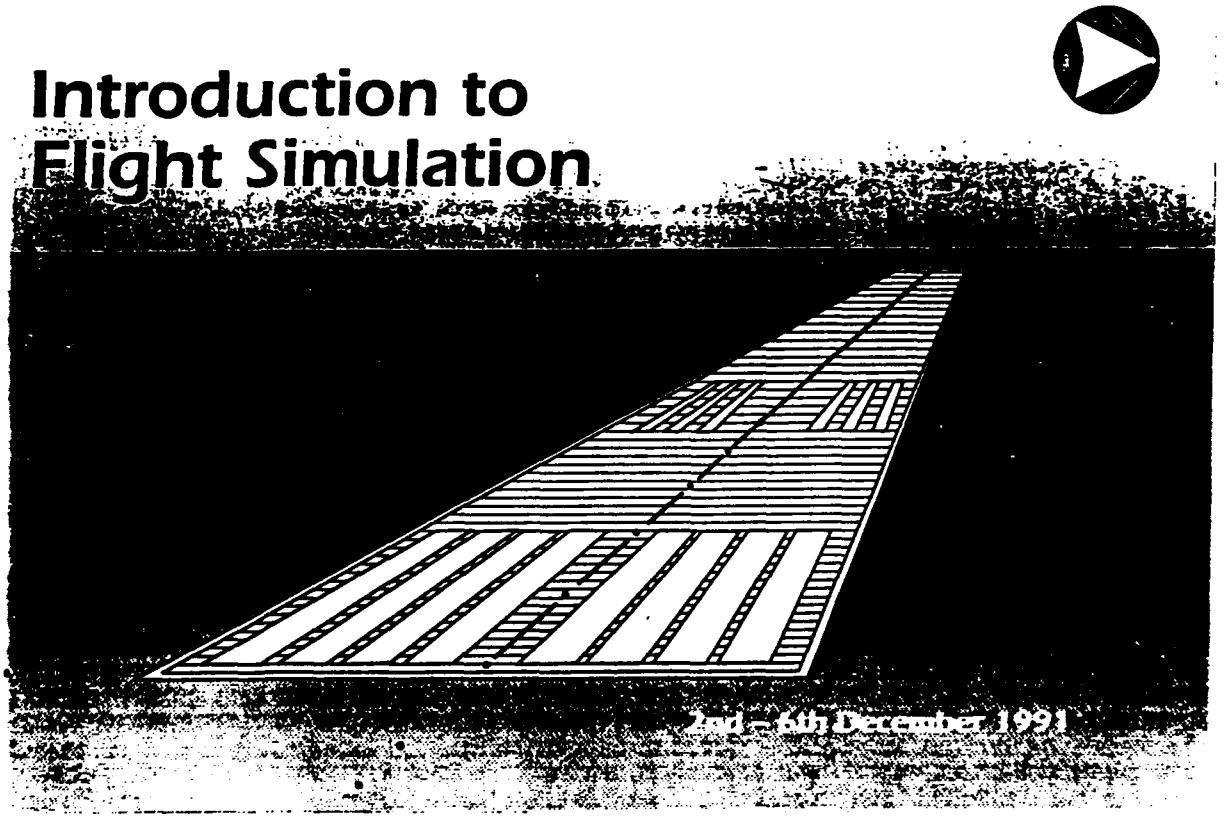
Account name/no _____

Signature _____

Telephone registration: 607-777-2154, weekdays 9 am-4 pm, or FAX 607-777-4822.
All registrations after December 13 MUST BE FAXED OR CALLED IN.

Mail completed registration form to:
Watson School Continuing Education
State University at Binghamton
PO Box 6000
Binghamton, NY 13902-6000

BINGHAMPTON ANNOUNCEMENT



CRANFIELD ANNOUNCEMENT

Introduction

Although flight simulation plays a very large part in aviation development and training there is very little consideration given to the subject in either aeronautical engineering or computing degree courses. Consequently those graduates entering the flight simulation industry have little background on which to start their career.

The purpose of this course is to extend the degree level coursework to introduce the principles involved in flight simulation so that a good foundation is laid for career development. The course will be both analytical and descriptive so that it will also be suitable for simulator system managers or maintenance engineers who could benefit from a course which would broaden their knowledge.

The course was developed in conjunction with the Royal Aeronautical Society Flight Simulation Group who continue to give their support and approval.

The Course

The philosophy of the course is to provide a coordinated coverage of the principal elements of a flight simulation system, modelling, software, motion and vision systems, through to its application in training and research. To achieve this objective the following topics will be covered:

- Introduction and Elements of Simulation
- Modelling of Framework and Coordinates, Aircraft and Environment, Avionics and Systems, Cockpit Sound and Feel
- Real-time Computing and Software Systems
- Motion Cueing Principles and Systems
- Vision Cueing Principles and Systems
- Instructor and Operator Stations
- Overall Systems Approach and Management
- Certification of Simulator Systems
- Civil, Military and Research Applications

The papers will be presented by practising specialists in flight simulation from industry and research organisations. Attention is paid to the integration of the material of these expert contributions into a coherent presentation of modern flight simulator systems. Each specialist session will be followed by a period for open discussion to enable the participants to clarify or extend the topic and experience has shown that, because of the wide-ranging backgrounds of the delegates, the discussion can be very lively.

Visits to simulator installations are included to provide a practical appreciation of the principles covered by the course.

The Speakers

The lectures are presented by specialists from the leading industries and research establishments involved in flight simulation. Their illustrative material is based on modern systems and techniques of current interest.

Qualifications for entry

Whilst no precise academic requirements are laid down the course will be of great benefit to those possessing a degree in engineering, physics or mathematics; alternatively the course will be suitable for those of lower academic qualification but who have experience in the simulation or aircraft industry.

Fee

The tuition fee of £850 covers course notes and a copy of "Flight Simulation" by J. Rolfe & K. Staples. The accommodation fee of £230 covers full board residence from Sunday afternoon until Friday after lunch.

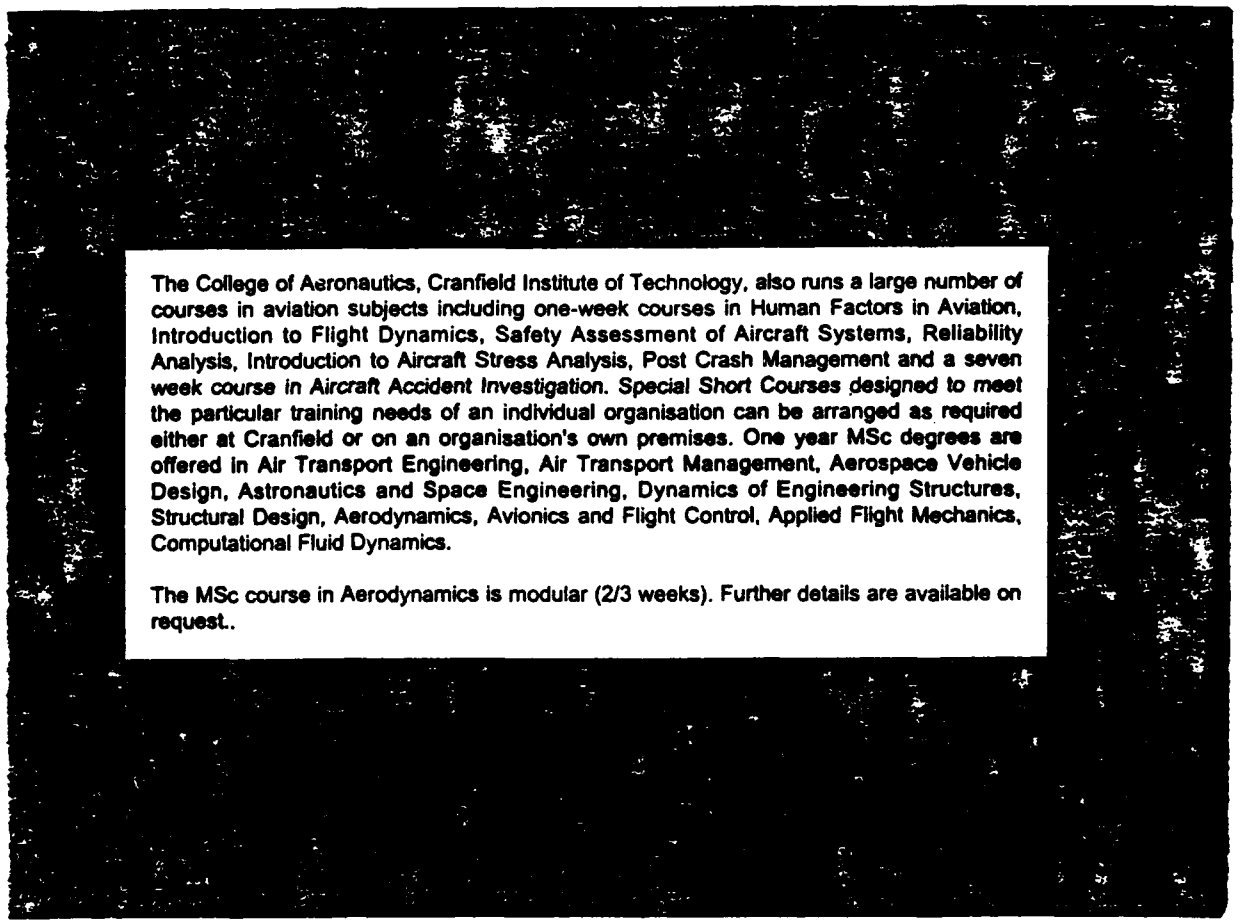
General Information

The members of the course will be accommodated in individual study/bedrooms in one of the residential halls situated on the Institute campus. Full assembly instructions will be sent to members shortly before the course begins. The Institute is situated between Bedford and Milton Keynes, within easy reach of London and the Midlands and readily accessible by the M1, or by rail to Bedford or Milton Keynes and thence by bus or taxi.

Enquiries

Further information may be obtained from:
Course Director – Dr Martin E. Eshelby (0234) 750111 Ext. 2118
or
Mrs J.A. Yeomans (0234) 752744
or
Miss A.L. Roff (0234) 750111 Ext. 3564
Cranfield Institute of Technology, Cranfield, Bedford MK43 0AL.
Telephone: Bedford (0234) 750111. Telex: 825072. Fax: (0234) 751206

CRANFIELD ANNOUNCEMENT



The College of Aeronautics, Cranfield Institute of Technology, also runs a large number of courses in aviation subjects including one-week courses in Human Factors in Aviation, Introduction to Flight Dynamics, Safety Assessment of Aircraft Systems, Reliability Analysis, Introduction to Aircraft Stress Analysis, Post Crash Management and a seven week course in Aircraft Accident Investigation. Special Short Courses designed to meet the particular training needs of an individual organisation can be arranged as required either at Cranfield or on an organisation's own premises. One year MSc degrees are offered in Air Transport Engineering, Air Transport Management, Aerospace Vehicle Design, Astronautics and Space Engineering, Dynamics of Engineering Structures, Structural Design, Aerodynamics, Avionics and Flight Control, Applied Flight Mechanics, Computational Fluid Dynamics.

The MSc course in Aerodynamics is modular (2/3 weeks). Further details are available on request..

CRANFIELD ANNOUNCEMENT

APPENDIX B

ESTIMATE LETTER

Binghamton

State University of New York at Binghamton
P.O. Box 6000, Binghamton, New York 13902-6000

Office of Continuing Education
Thomas J. Watson School of Engineering,
Applied Science, and Technology
Telephone (607) 777-2154

January 20, 1992

Mr. Theos D McKinney Jr.
U.S. Department of Transportation
Federal Aviation Administration
ACN 360
Atlantic City Airport, NJ 08405

Dear Mr. McKinney:

Pursuant to our discussions during the flight simulation short course, I have compiled program cost information regarding a possible offering of the program in Atlanta Georgia. Late Summer or early Fall would probably be most convenient from our perspective. However, the dates remain flexible based on your requirements.

I estimate that we could offer the program following the same curriculum and length for $ 1,350.00 per person with a minimum enrollment of thirty five people. If you decide to hold the program in Oklahoma City, the cost might vary a little based on airline expenses. I suspect that the differences are marginal though.

In calculating the costs for the program, I used several assumptions based on our preliminary discussions last week.
these include the following:

* The individuals would be responsible for buying their own lunches and dinners.
* The Monday evening "get acquainted" reception would be dropped from the schedule as would the Thursday evening dinner and after dinner speaker.
* Your organization would arrange for and pay any rental for audio visual equipment. This equipment includes: a large-screen projection unit with both 3/4 and 1/2 inch video tape capability, a light pointer, a 35 mm slide projector and four to six trays, two overhead projectors, and screens for both. Lastly, Grant McMillan used a PC with a projection unit this year. This could be eliminated if needed.
* The participants would be responsible for their own lodging arrangements and related costs.

We would provide refreshments at the breaks and before class each day.

If you decide to add any items to our side of the arrangement, the costs would need to be reflected in the registration fee.

An alternative might be to open the program up to some other organizations in the Atlanta region such as the U.S. Coast Guard, Delta Airlines, etc. The registration fees from those participants could be used off-set additional costs associated with the added services.

Please feel free to call if you need any additional information. The prospect of offering the program for the FAA in Atlanta is very exciting and I hope that we can make this a reality.

Sincerely,

Gary J Arnold
Director of Continuing Education

APPENDIX C

ACADEMY COURSE ANNOUNCEMENT

22102, FLIGHT SIMULATOR EVALUATION

Class Length: 40 hours Training Manager: AAC-951A

THIS COURSE IS FOR AIR CARRIER/GENERAL OPERATIONS INSPECTORS. IT CONSISTS OF CLASSROOM/SIMULATOR LABORATORY INSTRUCTION IN THE TECHNIQUES, PROCEDURES, POLICIES AND CRITERIA OF EVALUATING AND APPROVING FLIGHT SIMULATIONS USED IN TRAINING PROGRAMS. THE TRAINING PROVIDED ENABLES INSPECTORS TO INITIALLY CERTIFY AND APPROVE SIMULATORS/VISUAL SYSTEMS QUARTERLY. INSPECTORS USE FOKKER CONTROL LOADING TEST, MOTION TEST, AND VISUAL TEST EQUIPMENT. OTHER REQUIREMENTS: POSSESS AN ATP CERTIFICATE WITH A TYPE RATING IN AT LEAST ONE LARGE TURBINE-POWERED TRANSPORT AIRPLANE OR LIGHT TWIN JET EXECUTIVE TRANSPORT.

Prerequisites: None